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Energy management system implementation in Latvian municipalities: from theory to practice

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Abstract

This research analyses opportunities and procedures how an energy management system can be implemented in municipalities. The goal of this research is to develop guidelines for energy management system (EnMS) implementation in municipalities according to standard EN ISO 50001:2011 "Energy management systems – Requirements with guidance for use (ISO 50001:2011" [1]. The work is based both on theoretical sources of information and on practical research. The most relevant data of municipalities were considered. Objectives of this work are literature analysis, assessment of the current situation in municipality energy consumption, develop the procedure for implementing EnMS in municipalities, develop guidelines for EnMS implementation and develop policy instrument to stimulate implementation of EnMS in city and regional municipalities in Latvia. This topic is topical at the moment as the goal of Latvia is to increase the renewable energy share of gross final energy consumption to 40 % in year 2020, to reach 0.668 million tons of oil equivalent (Mtoe) of energy savings in year 2020 compared to forecasts of year 2007 and limit the country`s total greenhouse gas emissions in year 2020 so that they do not exceed 12.19 Mtoe [2].

Research showed that implementation of EnMS is an appropriate solution to ensure energy savings. Its implementation pays off already after the first year even in a small municipality with a population of around 6 000. In order to successfully implement EnMS in a municipality, it is necessary to receive support from political parties, involve staff from different departments, the administrative process must be minimized, as well as regular meetings and an information campaign are necessary.

A credible indicator was obtained with close correlation by which it is possible to identify potential energy savings from EnMS implementation to municipalities that do not have developed sustainable energy action plans and that do not know their energy consumption. An EnMS implementation procedure was developed based on the data and structure of the municipality of the city of Daugavpils. The management, employee and other involved person responsibilities, as well as an EnMS implementation working group were established, and potential savings from EnMS implementation, work/data/cost flow and energy management funding scheme were estimated. This procedure can also be applied to other municipalities.

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Based upon the analyzed information and data, guidelines for EnMS in municipalities to facilitate implementation of the system were developed and offered the most appropriate policy instrument in the current situation to encourage municipalities to implement EnMS. This political instrument that is included in the draft law "Energy Efficiency Law" obliges 9 largest cities to implement and certify EnMS according to ISO 50001 standard by 1 July 2016, but the regional municipalities whose territories development level index on 31 December 2015 is greater than 0.5 and population is more than 10 000 on their municipality implement EnMS according to ISO 50001 standard by 1 July 2017. This obligation will give 5.92 % or 586 gigawatt-hours (GWh) in the cumulative mandatory national energy savings target in the period from 2014 – 2020 and it will also encourage other municipalities to implement EnMS.

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Keywords: energy management systems; energy plans; energy efficiency; renewable energy; ISO 50001

1. Introduction

Rising energy costs and price volatility in combination with reduced energy supplies reinforces the risks associated with energy use. At the same time the role of energy efficiency, energy management and renewable energy in reducing these risks increases. To control and reduce energy consumption in a sustainable and cost-effective way, a variety of energy management systems and a variety of international standards have been developed. One of these standards is EN ISO 50001:2011 "Energy management systems – Requirements with guidance for use (ISO 50001:2011)" [1]. On the basis of this standard guidelines have been developed for energy management system implementation in Latvian municipalities. The aim of this standard is to enable organizations to establish a system in a structured manner and with continuous activities to promote improvements in energy efficiency.

It is necessary to develop guidelines for the implementation of energy management system in municipalities to facilitate energy management system implementation. One must analyze and take as an example other countries' experience in the implementation of energy management systems. To identify potential energy savings from energy management system implementation in municipalities, it is necessary to analyze energy consumption of municipalities in different Latvian cities and regional governments, which have developed a sustainable energy action plan. It is desirable to develop a single energy management system implementation procedure in a municipality, based on the regional government structure and energy consumption data. It is also necessary to develop policy instruments to stimulate the implementation of energy management systems in Latvian cities and regional governments, and promote an understanding of energy management systems, to show good examples and positive impact of the implementation of this system [3].

One should pay attention to several issues affecting the energy management system. For example, how, in a simple and effective way, the national government can get regional energy consumption and savings data in order to include it in the overall national energy efficiency target. The government at the national level is required to establish a sustainable mechanism to stimulate energy management system implementation in municipalities and to further share their experiences with other municipalities.

2. Energy management system

An energy management system is a set of interrelated or interacting elements of a plan which sets an energy efficiency objective and a strategy to achieve that objective [4]. There are three areas in energy management in which improvements are made - people, technology, and results evaluation. The implementation of the energy management system is changing people's behaviour and culture, training them and setting responsibilities. In implementation of energy management system, the best available (energy-efficient) technologies are selected with eco-design and ensure its correct operation and maintenance. Energy management implementation leads to performance assessment with statistics and data analysis. These processes are characterized by the principle of "plan, do, check, act". Energy management aims to reduce energy consumption and to do this it is necessary to take measures which should be planned at the start and then implemented. However, prior to the implementation of measures and drafting of a plan, responsibilities should be set for those who will carry out these activities and the plan is to be developed from which

such persons can seek guidance. It is also necessary to determine who will perform the monitoring and analyze whether the implementation of measures leads to energy consumption target [5].

2.1. Data

Data from municipality sustainable energy action plans was collected in order to make the regression analysis. In those municipalities in which implementation of energy management systems is planned but there is no energy consumption data available, it is necessary to make assumptions on the basis of which to calculate the total amount of energy savings in these municipalities. With regression analysis, the most credible indicator selected was municipality energy consumption in relation to the population of the city or region. Municipality energy consumption in relation to other indicators showed a weak or moderate correlation. The correlation between municipal buildings heat consumption and population in the city or region is showed in Fig. 1.

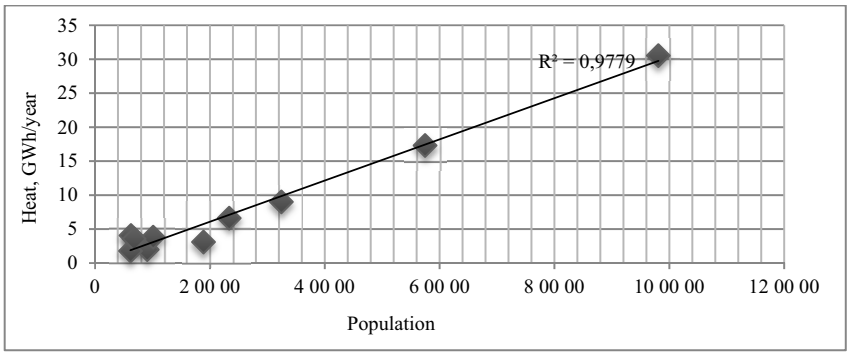

Fig. 1. Heat consumption in municipal buildings, depending on the municipality's population.

In Fig. 1 it can be seen that the coefficient of determination (R^2), which shows what the correlation is between heat consumption and the municipality`s population is greater than 0.97 which means that this correlation is very close. The correlation between municipal electricity consumption and population is showed in Fig. 2 and in this case coefficient of determination is greater than 0.95.

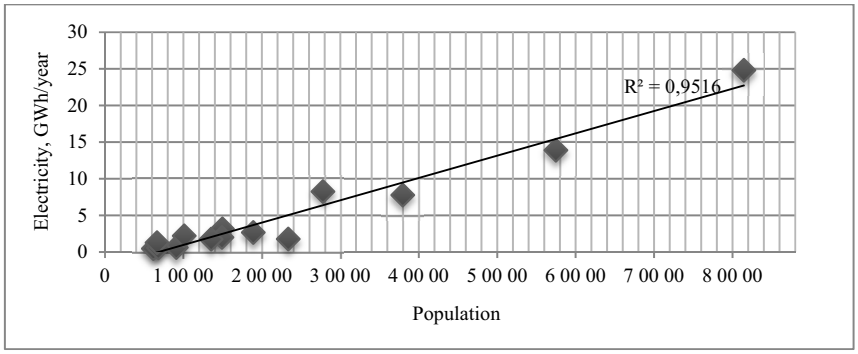

Fig. 2. Electricity consumption in municipal buildings, depending on the municipality's population.

By assessing the available Latvian city and county municipal heat and power consumption, which can be found in the sustainable energy action plans, the average heat consumption in municipal buildings against to a municipality's population is calculated as 304 kWh. For electricity consumed by municipal buildings and public lighting, the indicator is 219 kWh to the municipality's population. If it is assumed that the energy system in the first year after its

implementation gives 5 % energy savings, then the average heat savings would be 15.18 kWh and the average electricity savings would be 10.93 kWh.

In order for the indicator, it is necessary to obtain the energy consumption data for as many municipalities as possible. One of the causes of differences in heat consumption is a municipal building insulation that includes both number of insulated municipal buildings and the year when insulation is completed. Levels of electricity consumption differ among municipalities as a result of varying efficiency measures implemented and due to how much of the electricity is used for heating and hot water heating.

2.2. Guidelines

The guidelines are designed for municipalities in order to facilitate the process of energy management system implementation. Since municipalities can choose whether they involve a consultant in the process of for energy management system implementation or do it themselves, it is necessary to provide municipalities with more detailed information on energy management system implementation.

At first it is necessary to confirm procedure for energy management system implementation in a municipality. The municipality must create an energy management system implementation working group which is included into the municipality management system, specify the responsibilities of the working group and determine the boundaries and scope of the system. The working group should include municipal employees who are in charge of the development of the system, implementation of energy efficiency measures, and monitoring of the results achieved [5].

The energy management system in a municipality shall cover municipal authorities, local transport, public lighting, public procurement, etc., and it is possible that it also covers capital companies in which the municipality holds shares. Describe the energy consumption data flow for energy management system implementation in the organizational structure. Set short-term and long-term energy savings targets (can also be the share of renewable energy and CO_2 reduction targets). Specify if other municipal planning documents refer to energy savings or energy efficiency as a priority. Identify barriers for the energy management system. Assess the necessary resources needed to implement and maintain the system. Create a framework for energy management financing and contracting [5].

The energy planning section shall contain the following key points:

- Identification of major energy consumers;
- Identification of key individuals;
- Indicator determination to follow the trajectory of energy efficiency improvement;
- Set critical operational parameters;
- Set objectives and targets;
- Create energy action plan;
- Select the method of data and outcomes;
- Create training plan;
- Calculate expected energy consumption in the next period [5].

Identification of the major energy consumers include:

- How much and what type of energy is used in the municipality;
- Where this energy is spent;
- What are the most important consumers of energy, what forms of energy they use and what affects their use;
- Whether it is necessary to carry out an energy audit [5].

Next energy consumption optimization and the establishment of an energy consumption baseline scenario must be carried out. Set high, medium and low priority measures and identify necessary funding for these measures. Identify any measures that do not require financial contributions, and if they are with high priority carry them out as the first. Table. 1 shows high, medium and low priority measures to be taken and the necessary funding.

Table 1. Energy management system implementation measures.

Measure	Priority	Implementation period	Required financing, euro
Organizational changes	High	1 month	0
Staff training	High	3 months	200
Energy supplier review	Low	1 month	0
Public information	Medium	Continuously	300 (year)
Individual heat meter installation	High	1 month	1100

Record data in the form of tables and display them graphically. Implement measures and check results. Results are summarized in management review and presented in annual or in more frequent meetings. Inform the responsible Ministry about the total energy consumption and the energy savings so these savings are included in the national-level energy efficiency target [6].

3. Conclusion

Implementation of an energy management system is an appropriate solution to ensure energy savings. In order to successfully implement an energy management system in a municipality it is necessary to receive support from municipal authorities, involve staff from different departments, the administration process must be minimized, and it is necessary for regular meetings and an information campaign.

A credible indicator was obtained by which it is possible to identify potential energy savings from energy management system implementation to municipalities that do not have sustainable energy action plans developed and that do not know their energy consumption. An energy management system implementation procedure is developed based on the data and structure of the municipality of the city of Daugavpils.

Based upon the analyzed information and data, guidelines for EnMS in municipalities to facilitate implementation of the system were developed. Also political instrument that obliges 9 largest cities and regional municipalities to implement and certify an energy management system according to the ISO 50001 standard were offered. This will encourage other municipalities to introduce energy management systems.

Further work must be done on developing a simple and effective system on how the national government can get energy consumption and savings data from municipalities so they can be included in the total national energy efficiency target. Municipalities, which introduce or have introduced energy management systems, should engage in the exchange of experience with municipalities, where the introduction of energy management system is still being planned. National authorities are required to establish a sustainable mechanism to stimulate energy management system in municipalities. Governing authorities must enhance competition among accredited institutions that are authorized to certify the implementation of the energy management system according to the ISO 50001 standard.

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